Canada

Research & Development Highlights

Technical Series 90-240

Wet-Sprayed Cellulose Insulation in Wood-Frame Construction

Introduction

Cellulose insulation is usually installed dry in horizontal cavities such as attics. Manufacturers claim it can be used in vertical cavities with an adhesive binder if water is added as it is blown into the cavity. The wateractivates the binder, which sets the cellulose.

Manufacturers claim wet-sprayed cellulose insulation is cheaper to install and works better than glass-fibre baus because it leaks less air, transmits less noise and does not absorb as much moisture. They also claim that the water will not damage wood framing and sheathing.

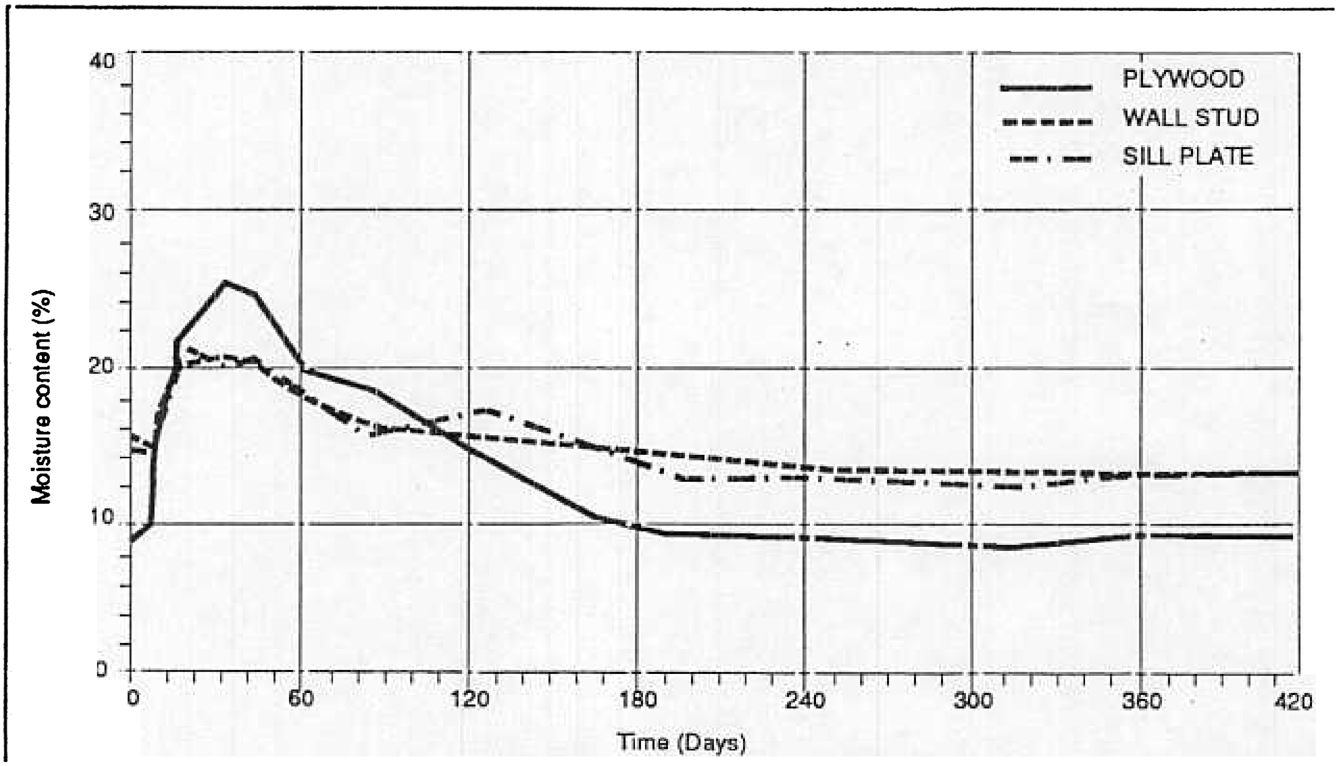
CMHC commissioned a test project to evaluate these claims. The project's objectives were to determine:

- the drying rates of building materials surrounding the cellulose insulation;
- whether building materials would suffer moisture damage; and
- whether cellulose insulation would be an effective air barrier

The Test House

Testing took place in a two-storey, detached wood-frame house in Alberta. The house was built to R-2000 airtightness standards. Its attic and subfloor rim joist junctions were not gasketed and its electrical outlets were left unsealed so that the tests would show how airtight the cellulose alone would make the house.

Dry-blown cellulose was installed in the ceilings and wet-sprayed cellulose in the walls and rim joists. To evaluate the effects of different construction techniques, the south wall of the house included four sections:



Average wall moisture contents

CMHC SCHL
Helping to house Canadians

- standard construction;
- standard construction without a polyethylene vapour barrier;
- standard construction without a polyethylene vapour barrier, and with several *25* mm vent holes through the exterior wall (maximum ventilalion through the wall); and
- standard construction with a tightly sealed cavity (minimum ventilation through the wall).

Moisture and temperature sensors were inserted in sections of the north, south and east walls.

Findings

Wood Moisture

Sections of the frame adjacent to the dry insulation showed normal absorption and drying rates. After the wet-sprayed cellulose was installed, the plywood's sheathing moisture level increased to 26% after 30 days, decreased to near original levels (15%) after 160 days, and dried 1% more by the end of the test (420 days).

The framing timbers' moisture level increased to 22% in the first 10 days, dried to slightly over original levels (9%) after 80 days, and then dried 3% more by the end of the test (420 days). From these observations, the study concluded:

- plywood absorbed more moisture and dried out more quickly than framing timbers; and
- wall and sill timbers had similar absorption and drying rates.

Moisture Damage

The study looked for four kinds of moisture damage:

Corroded metal fasteners

Siding nails tend to corrode, so galvanized nails were used and the siding was made as watertight as possible. About 30% of the siding nails examined were at least partly corroded, especially where they penetrated wood, because both the nails' protective coating and the amount of moisture varied.

Wood fungi

The cellulose insulation contained a wood fungicide, but traces of fungi were found in the north wall between the plywood and the framing timber. The fungicide probably did not reach this location because it had no direct contact with the cellulose.

Shrinking and Warping

Saturated wood usually returns to its normal dimensions when it dries. The wall timbers did not shrink or warp abnormally.

Deteriorated bonding in plywood

A year after the insulation was installed, the plywood panels were firmly bonded and apparently unaffected by moisture.

Airtightness

When the house was fully constructed and still very wet, researchers measured a rate of 1.58 air changes per hour (ac/h) at 50 Pa

During the year, tests found air change rates of *1.95,* 2.01 and 2.00 ac/h, at 50 Pa. Where rim joist cavities were completely filled with cellulose, very little air leaked from the duct openings. In the walls, only electrical outlets showed any trace of air leaks.

Pressure drop tests were used to determine which wall components blocked the most air.

The plywood exterior sheathing was the principal air barrier, followed by the gypsum board, polyethylene and cellulose. The joints in the sheathing, originally 3 mm wide, had swollen almost tight; this increased the plywood's airtightness. Wing holes in the interior gypsum board interconnected many cavities and reduced its airtightness. If the electrical outlets had been sealed or the plywood joints made a little looser, the results of these tests might have been differenL The cellulose was not very effective in reducing air flow.

Occupants' Comments

The occupants of the house made three major comments:

- Heating costs were low during the year of the test.
- The house was quieter than any other they had lived in.
- The cellulose insulation in the basement should have been covered to protect it and prevent the release of cellulose fibres into the air. Cellulose fibre is not known to be harmful, but the insulation binder could contain chemicals which might be.

Conclusions

- Wet-sprayed cellulose insulation nearly saturates wood framing, but within six months the framing will dry almost to the level before installation, even during winter.

- **Sill** plates and wall studs gained and lost moisture at about the same rate. This suggests that most of the sprayed moisture did not drain through the sill plates.
- The insulation dried faster in the wall sections where there was high ventilation and no polyethylene. Insulation exposed to the indoors dried faster than insulation in closed-in cavities.
- The drying rate was affected by air temperatures, humidity, ventilation of the insulated cavity, orientation, time allowed before installing gypsum board and other construction conditions.
- One year after construction, the house had deteriorated little. Some nails were slightly corroded and a few fungi were found in one wall.
- Cellulose insulation is not an effective air barrier.

Project Manager: Norbert Koeck

Research Report: Field Monitoring of Cellulose in Walls—Edmonton

Research Consultant: Building Envelope Engineering

A full report on this research project is available from the Canadian Housing Information Centre at the address below.

Housing Research at CMHC

Under Part IX of the National Housing Act, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This factsheet is one of a series intended to inform you of the nature and scope of CMHC's technical research program.

This Research and Development Highlights factsheet is one of a wide variety of housing-related publications produced by CMHC.

For a complete list of Research and Development Highlights, or for more information on CMHC housing research and information, please contact:

**The Canadian Housing Information Centre
Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa (Ontario)
K1A 0P7**

**Telephone: (613) 748-2367
Fax: (613) 748-2098**

Cette publication est aussi disponible en français.

The information in this publication represents the latest knowledge available to CMLIC at the time of publication, and has been thoroughly reviewed by experts in the housing field. CMHC, however, assumes no liability for any damage, injury, expense or loss that may result from use of this information.

Moisture in 2200 SF 2 story home insulated w/wet spray cellulose

2200 divided by 2 = 1100 SF per floor
1100 SF per floor would be approx 24 by 45 ft

number of stories = 2
wall height (ft) = 8
% of wall area windows/doors = 10
% of wall area framed = 25 (framing factor)
depth of wall cavity (in) = 3.50

initial weight of cellulose sprayed
in pounds per cubic foot = 5.50

stabilized weight of cellulose
in pounds per cubic foot = 2.60

dry weight of cellulose
in pounds per cubic foot = 2.30

home	length (ft)	width (ft)	
	45	24	
		linear feet of wall	276 ft.
		gross wall area	2208 sq.ft.
		insulated wall area	1435 sq.ft.

density of water 62.4 lbs/ft^3
1 ft^3 = 7.481 gallons

volume of wall containing
cellulose insulation = 419 cubic ft.

water sprayed in home 1340 pounds
at installation = 161 gallons
21 cubic ft.

water remaining in 126 pounds
home after stabilizing = 15 gallons
2 cubic ft.